

WHAT IS CLAIMED IS:

1. A liquid crystal display apparatus comprising:

a liquid crystal layer held between a pair of substrates, at least one thereof being transparent;

a plurality of line wirings and a plurality of column wirings disposed on one of the substrates; and

first active elements in intersections of the plurality of line wirings and the plurality of column wirings,

wherein an image is displayed by writing image data in pixels disposed in a matrix form through the first active elements, preset writing is executed on a full surface of a screen in synchronization with a frame signal, the image is made visible by intermittently lighting an illuminator, both polarities, positive and negative, are displayed in one frame period, a period obtained by subtracting a preset displaying period of each line from the one frame period is substantially equally distributed between positive polarity displaying and negative polarity displaying of one line, and then displaying is carried out.

2. A liquid crystal display apparatus comprising:

a liquid crystal layer held between a pair of transparent substrates, at least one thereof being

transparent;

a plurality of line wirings and a plurality of column wirings disposed on one of the substrates; and

first active elements in intersections of the pluralities of line and column wirings,

wherein an image is displayed by writing image data in pixels disposed in a matrix form through the first active elements, preset writing is executed on a full surface of a screen in synchronization with a frame signal, the image is made visible by intermittently lighting an illuminator, one frame period is divided into a first writing period, a first holding period, a second writing period, a second holding period, and a reset writing period, the liquid crystal display apparatus is driven in this sequence, voltage polarities of the first and second writing periods are reversed, and the second writing period is set to be about 1/2 of the first writing period.

3. A liquid crystal display apparatus according to claim 2, wherein the second writing period is started after a passage of about 1/2 of a period obtained by subtracting a presetting period from one frame period.

4. A liquid crystal display apparatus according to claim 1, wherein the first holding period is set to be substantially zero.

5. A liquid crystal display apparatus according

to claim 1, wherein in each writing period, writing polarities are similar to each other on a full surface of the screen.

6. A liquid crystal display apparatus according to claim 5, wherein a potential of a common electrode as a reference for a potential a pixel wiring is varied between the first and second writing periods.

7. A liquid crystal display apparatus according to claim 1, wherein a second holding period and a lighting period of the illuminator are substantially equal to each other.

8. A liquid crystal display apparatus according to claim 1, wherein at least in a lighting period of the illuminator, all the column wirings are fixed to predetermined potentials.

9. A liquid crystal display apparatus according to claim 8, wherein each of the predetermined potentials is one selected from a black-displaying potential and a displaying potential of a slow optical response speed.

10. A liquid crystal display apparatus comprising:

a liquid crystal layer held between a pair of substrates, at least one thereof being transparent; a plurality of line wirings and a plurality of column wirings disposed on one of the substrates; and

first active elements in intersections of the pluralities of line and column wirings,

wherein an image is displayed by writing image data in pixels disposed in a matrix form through the first active elements, the image is made visible by intermittently lighting an illuminator, scanning is started from one line or a pair of adjacent lines, one or more lines being present in a screen, and the scanning is carried out in both upper and lower directions with the one line or the pair of adjacent lines set as a reference.

11. A liquid crystal display apparatus according to claim 10, wherein the illuminator is lit for a predetermined period from an end time of scanning of all lines in the screen to a starting time of scanning of a next frame.

12. A liquid crystal display apparatus according to claim 10, wherein lines of upper-direction scanning and lines of lower-direction scanning are simultaneously selected.

13. A liquid crystal display apparatus according to claim 10, wherein lines of upper-direction scanning and lines of lower-direction scanning are alternately selected.

14. A liquid crystal display apparatus according to claim 13, wherein a selection period of a line to be selected next is overlapped in a selection period of a predetermined line.

15. A liquid crystal display apparatus according to claim 14, wherein the overlapped period is 1/2 of

one selection period.

16. A liquid crystal display apparatus according to claim 10, further comprising a holding capacitor between a line wiring of a previous state and a pixel electrode in a scanning direction,

wherein shapes and disposing intervals of opening portions including a boundary of areas of different scanning directions are substantially constant.

17. A liquid crystal display apparatus comprising:

a liquid crystal layer held between a pair of substrates, at least one thereof being transparent;

a plurality of line wirings and a plurality of column wirings disposed on one of the substrates; and

first active elements in intersections of the pluralities of line and column wirings,

wherein an image is displayed by writing image data in pixels disposed in a matrix form through the first active elements, preset writing is executed on a full surface of a screen in synchronization with a frame signal, the image is made visible by intermittently lighting an illuminator, scanning is started from one line or a pair of adjacent lines, one or more lines being present in a screen, and the scanning is carried out in both upper and lower directions with the one line or the pair of adjacent lines set as a

reference.

18. A liquid crystal display apparatus according to claim 17, wherein the illuminator is lit for a predetermined period from an end time of scanning of all lines in the screen to a starting time of scanning of a next frame.

19. A liquid crystal display apparatus according to claim 17, wherein lines of upper-direction scanning and lines of lower-direction scanning are simultaneously selected.

20. A liquid crystal display apparatus according to claim 17, wherein lines of upper-direction scanning and lines of lower-direction scanning are alternately selected.

21. A liquid crystal display apparatus according to claim 20, wherein a selection period of a line to be selected next is overlapped in a selection period of an optional line.

22. A liquid crystal display apparatus according to claim 21, wherein the overlapped period is 1/2 of one selection period.

23. A liquid crystal display apparatus comprising:

    a liquid crystal layer held between a pair of substrates, at least one thereof being transparent;

    a plurality of line wirings and a plurality of column wirings disposed on one of the substrates; and

first active elements in intersections of the pluralities of line and column wirings,

wherein an image is displayed by writing image data in pixels disposed in a matrix form through the first active elements, the image is made visible by intermittently lighting an illuminator, division is made into the number  $2n$  of subframes in one frame period, the same image data is subjected to write-scanning while a writing polarity is reversed for each of the subframes, and the illuminator is intermittently lit in a predetermined period of a latter half of one frame.

24. A liquid crystal display apparatus according to claim 1, wherein scanning is started from one line or a pair of adjacent lines, one or more lines being present in a screen, and the scanning is carried out in both upper and lower directions with the one line or the pair of adjacent lines set as a reference.

25. A liquid crystal display apparatus according to claim 1, wherein a plurality of lines are simultaneously selected, and the same data is written in the plurality of lines.

26. A liquid crystal display apparatus according to claim 25, wherein the number of simultaneously selected lines is two, and two starting lines making a pair are alternated with other two to be odd and even lines for each frame.

27. A liquid crystal display apparatus according

to claim 26, wherein image data written in the two lines making a pair takes an average value of image signals of the two lines.

28. A liquid crystal display apparatus according to claim 26, wherein for the image data written in the two lines making a pair, selection of only image data of odd lines and selection of image data of even lines in a continuous frame are alternately repeated.

29. A liquid crystal display apparatus according to claim 1, further comprising a switch for discriminating motion and still images from each other, and a driving method of the illuminator is divided between the motion and still images.

30. A liquid crystal display apparatus according to claim 29, wherein the illuminator is flashed during displaying of the motion image, and always lit during displaying of the still image.

31. A liquid crystal display apparatus according to claim 30, wherein a switch is provided for dividing luminance of the illuminator between the displaying of the motion image and the displaying of the still image.

32. A liquid crystal display apparatus according to claim 1, wherein precharging is carried out by making conductive (ON state) the first active elements of  $m$  lines before a line selected for writing the image data.

33. A liquid crystal display apparatus according to claim 1, wherein line wirings excluding the line

selected for writing the image data and precharged lines are set in high resistance states.

34. A liquid crystal display apparatus according to claim 1, wherein a common electrode for establishing a potential of writing in the pixel is disposed in the pixel, and connected to common wirings for supplying a potential to the common electrode, and a high resistance state is set between those among the common wirings not related to at least the line selected for writing the image data and the precharged lines, and the common electrode receiving the potential from the common wirings.

35. A liquid crystal display apparatus according to claim 34, wherein a second active element is disposed between the common wiring and the common electrode, and the common wiring or the common electrode is connected to source and drain terminals of the second active element.

36. A liquid crystal display apparatus according to claim 35, wherein a gate electrode of the active element is connected to a gate wiring of its own pixel.

37. A liquid crystal display apparatus according to claim 36, wherein the gate electrode of the active element is connected to a gate wiring of a next stage adjacent in a scanning direction.

38. A liquid crystal display apparatus according to claim 1, wherein motion and still images are first discriminated from each other, for the motion image,

the same image data of a plurality of lines is written, and for the still image, image data is directly written.

39. A liquid crystal display apparatus according to claim 38, wherein the number of lines for wiring the same image data of the motion image is two, and two starting lines making a pair are alternated with other two to be odd lines and even lines for each frame.

40. A liquid crystal display apparatus according to claim 39, wherein among the image data of the two lines making a pair, image data of a line, from which writing is started before the other lines, is corrected based on a predetermined relation.

41. A liquid crystal display apparatus according to claim 40, wherein all the image data of the still image are corrected by a predetermined relation based on a difference in luminance with a peripheral pixel.

42. A liquid crystal display apparatus according to claim 5, wherein a black writing voltage of the second writing voltage is equal to/lower than a black writing voltage of the first writing period.

43. A liquid crystal display apparatus according to claim 1, wherein a writing polarity is set in order to set a potential difference between a high voltage  $V_{gh}$  and a voltage  $V_{dbk2}$  for black displaying during gate writing in the second writing period larger than a potential difference between a high voltage  $V_{gh}$  and a voltage  $V_{dbk1}$  for black displaying during gate writing

in the first writing period.

44. A liquid crystal display apparatus according to claim 2, wherein the preset writing is black writing.

45. A liquid crystal display apparatus comprising:

a liquid crystal layer held between a pair of substrates, at least one thereof being transparent;

a plurality of line wirings, a plurality of column wirings and a common wiring disposed on one of the substrates;

first active elements in intersections of the pluralities of line and column wirings,

wherein an image is displayed by writing image data in pixels disposed in a matrix form through the active elements, a pixel electrode and a common electrode are provided in the pixel, one end of the first active element is connected to the pixel electrode, the other end to the column wiring, second active elements are disposed in the pixel, one output thereof is connected to the common electrode, the other output to the common wiring, the first and second active elements are set in conductive states in a period of voltage writing in a liquid crystal, and a high resistance state is set in a holding period.

46. A liquid crystal display apparatus according to claim 45, wherein a potential of the common wiring is set to be an AC potential in synchronization with a

change in a polarity of the voltage writing in the liquid crystal.

47. A liquid crystal display apparatus according to claim 46, wherein the setting of the AC potential of the common wiring is carried out for each frame period or subframe period.

48. A liquid crystal display apparatus according to claim 45, further comprising a projection portion in a part of the common wiring,

wherein the projection portion is disposed to hold the column wiring, to be positioned between the column wiring, and the common electrode or one among pixel electrodes near the column wiring, or to cover the same.

49. A liquid crystal display apparatus according to claim 45, wherein a preset writing is executed on a full surface of a screen in synchronization with a frame signal, an image is made visible by intermittently lighting an illuminator, both polarities, positive and negative, are displayed in one frame period, and a residual period obtained by subtracting a preset displaying period of each line from one frame period is equally distributed to positive and negative polarity displayings of each line, and displaying is carried out.

50. A liquid crystal display apparatus according to claim 45, wherein preset writing is executed on a full surface of a screen in synchronization with a

frame signal, an image is made visible by intermittently lighting an illuminator, one frame period is divided into a preset writing period, a first writing period, a first holding period, a second writing period, and a second holding period, the liquid crystal apparatus is driven in this sequence, writing voltage polarities of the first and second writing periods are reversed, and the second writing period is set to be about 1/2 of the first writing period.

51. A liquid crystal display apparatus according to claim 45, wherein a capacity of each column wiring with the pixel electrode of each pixel is set equal to a capacity of each column wiring with the common electrode of each pixel.

52. A liquid crystal display apparatus according to claim 51, wherein the pixel electrode, the common electrode and the intersection are provided in the vicinity of a column-direction center of the pixel, and the pixel electrode and the common electrode are shaped to be linearly symmetrical in a column direction.

53. A liquid crystal display apparatus according to claim 1, wherein a display mode of the liquid crystal is an in-plane switching mode or a normally black mode, on which displaying is black when no voltage is applied to the liquid crystal.

54. A liquid crystal display apparatus according to claim 1, wherein the first active element for writing in the pixel is a high-mobility active element.

55. A liquid crystal display apparatus according to claim 54, the high-mobility active element is a polycrystal thin film transistor or a single crystal silicon transistor.

56. A liquid crystal display apparatus according to claim 1, wherein the common wirings are disposed in a meshed form.

57. A liquid crystal display apparatus according to claim 1, wherein the common wirings are disposed in parallel with the column wirings.

58. A liquid crystal display apparatus according to claim 1, wherein the illuminator uses a high-speed response light source.

59. A liquid crystal display apparatus according to claim 58, wherein the high-speed response light source is one selected from, or a combination of a light source using a field emission electron source (FED: field emission display), a light source of a plasma using emission type, a high-speed response fluorescent tube.

60. A liquid crystal display apparatus adapted to display both polarities, positive and negative, in one frame period, distribute a residual period obtained from subtracting a preset displaying period of each line from one frame period substantially equally to positive and negative polarity displayings of each line, and then carry out displaying.

61. A liquid crystal display apparatus adapted to

divide one frame period into a preset writing period, a first writing period, a first holding period, a second writing period, and a second holding period, to be driven in this sequence, reverse writing voltage polarities of the first and second writing periods, and set the second writing period to be about 1/2 of the first writing period.

APPLIED PHYSICS